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APPENDIX B

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Identification of p2y9/GPR23 as a novel G protein-coupled receptor for Lysophosphatidic acid, structurally distant from the Edg family

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Lysophosphatidic acid (LPA) is a bioactive lipid mediator with diverse physiological and pathological actions on many types of cells. LPA has been widely considered to elicit its biological functions through three types of G protein-coupled receptors, Edg (endothelial cell differentiation gene) 2/LPA1/Vzg (ventricular zone gene) 1, Edg4/LPA2 and Edg7/LPA3. We identified an orphan G protein-coupled receptor, p2y9/GPR23, as the fourth LPA receptor (LPA4). Membrane fractions of RH7777 cells transiently expressing p2y9/GPR23 displayed a specific binding for 1-oleoyl-LPA with a K_d value of around 45 nM. Competition binding and reporter gene assays showed that p2y9/GPR23 preferred structural analogs of LPA with a rank order of 1-oleoyl- > 1-stearoyl- > 1-palmitoyl- > 1-myristoyl- > 1-alkyl- > 1-alkenyl-LPA. In Chinese hamster ovary cells expressing p2y9/GPR23, 1-oleoyl-LPA induced an increase in [Ca²⁺]_i, and stimulated adenylyl cyclase activity. Quantitative Real time-PCR demonstrated that mRNA of p2y9/GPR23 was significantly abundant in ovary compared to other tissues. Interestingly, p2y9/GPR23 shares only 20-24% amino acid identities with Edg2, Edg4 and Edg7, and phylogenetic analysis also shows that p2y9/GPR23 is far distant from the Edg family. These facts suggest that p2y9/GPR23 has evolved from different ancestor sequences from the Edg family.

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C. Zhao, M. J. Fernandes, G. D. Prestwich, M. Turgeon, J. Di Battista, T. Clair, P. E. Poubelle, and S. G. Bourgoin

Regulation of Lysophosphatidic Acid Receptor Expression and Function in Human Synoviocytes: Implications for Rheumatoid Arthritis?

Mol. Pharmacol., February 1, 2008; 73(2): 587 - 600.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

☒ Home
page

J. Chen, A. R. Baydoun, R. Xu, L. Deng, X. Liu, W. Zhu, L. Shi, X. Cong, S. Hu, and X. Chen

Lysophosphatidic Acid Protects Mesenchymal Stem Cells Against Hypoxia and Serum Deprivation-Induced Apoptosis

Stem Cells, January 1, 2008; 26(1): 135 - 145.

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page

F.-T. Lin, Y.-J. Lai, N. Makarova, G. Tigyi, and W.-C. Lin

The Lysophosphatidic Acid 2 Receptor Mediates Down-regulation of Siva-1 to Promote Cell Survival

J. Biol. Chem., December 28, 2007; 282(52): 37759 - 37769.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

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page

K. Hama, J. Aoki, A. Inoue, T. Endo, T. Amano, R. Motoki, M. Kanai, X. Ye, J. Chun, N. Matsuki, *et al.*

Embryo Spacing and Implantation Timing Are Differentially Regulated by LPA3-Mediated Lysophosphatidic Acid Signaling in Mice

Biol Reprod, December 1, 2007; 77(6): 954 - 959.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

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page

M. M. Murph, J. Hurst-Kennedy, V. Newton, D. N. Brindley, and H. Radhakrishna

Lysophosphatidic Acid Decreases the Nuclear Localization and Cellular Abundance of the p53 Tumor Suppressor in A549 Lung Carcinoma Cells

Mol. Cancer Res., November 1, 2007; 5(11): 1201 - 1211.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

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page

K. M. Kassel, N. A. Schulte, S. M. Parker, A. D. Lanik, and M. L. Toews

Lysophosphatidic Acid Decreases Epidermal Growth Factor Receptor Binding in Airway Epithelial Cells

J. Pharmacol. Exp. Ther., October 1, 2007; 323(1): 109 - 118.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

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page

Y.-J. Lai, W.-C. Lin, and F.-T. Lin

PTPL1/FAP-1 Negatively Regulates TRIP6 Function in Lysophosphatidic Acid-induced Cell Migration

J. Biol. Chem., August 17, 2007; 282(33): 24381 - 24387.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

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page

C. E. Horak, J. H. Lee, A. G. Elkahloun, M. Boissan, S. Dumont, T. K. Maga, S. Arnaud-Dabernat, D. Palmieri, W. G. Stetler-Stevenson, M.-L. Lacombe, *et al.*

Nm23-H1 Suppresses Tumor Cell Motility by Down-regulating the Lysophosphatidic Acid Receptor EDG2

Cancer Res., August 1, 2007; 67(15): 7238 - 7246.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

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page

Y. Zhao, D. He, J. Zhao, L. Wang, A. R. Leff, E. Wm. Spannhake, S. Georas, and V. Natarajan

Lysophosphatidic Acid Induces Interleukin-13 (IL-13) Receptor {alpha}2 Expression and Inhibits IL-13 Signaling in Primary Human Bronchial Epithelial Cells

J. Biol. Chem., April 6, 2007; 282(14): 10172 - 10179.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

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page

K. Yanagida, S. Ishii, F. Hamano, K. Noguchi, and T. Shimizu

LPA4/p2y9/GPR23 Mediates Rho-dependent Morphological Changes in a Rat Neuronal Cell Line

J. Biol. Chem., February 23, 2007; 282(8): 5814 - 5824.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

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page

C.-W. Lee, R. Rivera, A. E. Dubin, and J. Chun

LPA4/GPR23 Is a Lysophosphatidic Acid (LPA) Receptor Utilizing Gs-, Gq/Gi-mediated Calcium Signaling and G12/13-mediated Rho Activation

J. Biol. Chem., February 16, 2007; 282(7): 4310 - 4317.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

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page

S. Choi, M. Lee, A. L. Shiu, S. J. Yo, and G. W. Aponte

Identification of a protein hydrolysate responsive G protein-coupled receptor in enterocytes

Am J Physiol Gastrointest Liver Physiol, January 1, 2007; 292(1): G98 - G112.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

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page

D.-J. Jun, J.-H. Lee, B.-H. Choi, T.-K. Koh, D.-C. Ha, M.-W. Jeong, and K.-T. Kim

Sphingosine-1-Phosphate Modulates Both Lipolysis and Leptin Production in Differentiated Rat White Adipocytes

Endocrinology, December 1, 2006; 147(12): 5835 - 5844.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

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page

S. Rieken, S. Herroeder, A. Sassmann, B. Wallenwein, A. Moers, S. Offermanns, and N. Wettschureck

Lysophospholipids Control Integrin-dependent Adhesion in Splenic B Cells through Gi and G12/G13 Family G-proteins but Not through Gq/G11

J. Biol. Chem., December 1, 2006; 281(48): 36985 - 36992.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

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page

M. Murph, T. Tanaka, S. Liu, and G. B. Mills

Of Spiders and Crabs: The Emergence of Lysophospholipids and Their Metabolic Pathways as Targets for Therapy in Cancer.

Clin. Cancer Res., November 15, 2006; 12(22): 6598 - 6602.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

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page

Z. Zhang, Z. Liu, and K. E. Meier

Lysophosphatidic acid as a mediator for proinflammatory agonists in a human corneal epithelial cell line

Am J Physiol Cell Physiol, November 1, 2006; 291(5): C1089 - C1098.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

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R. Guo, E. A. Kasbohm, P. Arora, C. J. Sample, B. Baban, N. Sud, P. Sivashanmugam, N. H. Moniri, and Y. Daaka

Expression and Function of Lysophosphatidic Acid LPA1 Receptor in Prostate Cancer Cells

Endocrinology, October 1, 2006; 147(10): 4883 - 4892.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

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page

M. P. Abbracchio, G. Burnstock, J.-M. Boeynaems, E. A. Barnard, J. L. Boyer, C. Kennedy, G. E. Knight, M. Fumagalli, C. Gachet, K. A. Jacobson, *et al.*

International Union of Pharmacology LVIII: Update on the P2Y G Protein-Coupled Nucleotide Receptors: From Molecular

Mechanisms and Pathophysiology to Therapy

Pharmacol. Rev., September 1, 2006; 58(3): 281 - 341.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

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page

M. Tanaka, S. Okudaira, Y. Kishi, R. Ohkawa, S. Iseki, M. Ota, S. Noji, Y. Yatomi, J. Aoki, and H. Arai

Autotaxin Stabilizes Blood Vessels and Is Required for Embryonic Vasculature by Producing Lysophosphatidic Acid

J. Biol. Chem., September 1, 2006; 281(35): 25822 - 25830.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

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page

C.-W. Lee, R. Rivera, S. Gardell, A. E. Dubin, and J. Chun

GPR92 as a New G12/13- and Gq-coupled Lysophosphatidic Acid Receptor That Increases cAMP, LPA5

J. Biol. Chem., August 18, 2006; 281(33): 23589 - 23597.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

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page

D. L. Baker, Y. Fujiwara, K. R. Pigg, R. Tsukahara, S. Kobayashi, H. Murofushi, A. Uchiyama, K. Murakami-Murofushi, E. Koh, R. W. Bandle, et al.

Carba Analogs of Cyclic Phosphatidic Acid Are Selective Inhibitors of Autotaxin and Cancer Cell Invasion and Metastasis

J. Biol. Chem., August 11, 2006; 281(32): 22786 - 22793.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

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page

K. Kotarsky, A. Boketoft, J. Bristulf, N. E. Nilsson, A. Norberg, S. Hansson, C. Owman, R. Sillard, L. M. F. Leeb-Lundberg, and B. Olde

Lysophosphatidic Acid Binds to and Activates GPR92, a G Protein-Coupled Receptor Highly Expressed in Gastrointestinal Lymphocytes

J. Pharmacol. Exp. Ther., August 1, 2006; 318(2): 619 - 628.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

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C. L. Sayas, A. Ariaens, B. Ponsioen, and W. H. Moolenaar

GSK-3 Is Activated by the Tyrosine Kinase Pyk2 during LPA1-mediated Neurite Retraction

Mol. Biol. Cell, April 1, 2006; 17(4): 1834 - 1844.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

K. S. Park, H.-Y. Lee, M.-K. Kim, E. H. Shin, S. H. Jo, S. D. Kim, D.-S. Im, and Y.-S. Bae

<input checked="" type="checkbox"/> Home page	Lysophosphatidylserine Stimulates L2071 Mouse Fibroblast Chemotactic Migration via a Process Involving Pertussis Toxin-Sensitive Trimeric G-Proteins
	Mol. Pharmacol., March 1, 2006; 69(3): 1066 - 1073.
	[Abstract] [Full Text] [PDF]

<input checked="" type="checkbox"/> Home page	T. Tsukahara, R. Tsukahara, S. Yasuda, N. Makarova, W. J. Valentine, P. Allison, H. Yuan, D. L. Baker, Z. Li, R. Bittman, <i>et al.</i>
	Different Residues Mediate Recognition of 1-O-Oleyllysophosphatidic Acid and Rosiglitazone in the Ligand Binding Domain of Peroxisome Proliferator-activated Receptor {gamma}
	J. Biol. Chem., February 10, 2006; 281(6): 3398 - 3407. [Abstract] [Full Text] [PDF]

<input checked="" type="checkbox"/> Home page	M. Rahaman, R. W. Costello, K. E. Belmonte, S. S. Gendy, and M.-T. Walsh
	Neutrophil Sphingosine 1-Phosphate and Lysophosphatidic Acid Receptors in Pneumonia
	Am. J. Respir. Cell Mol. Biol., February 1, 2006; 34(2): 233 - 241. [Abstract] [Full Text] [PDF]

<input checked="" type="checkbox"/> Home page	J. Rubenfeld, J. Guo, N. Sookrung, R. Chen, W. Chaicumpa, V. Casolaro, Y. Zhao, V. Natarajan, and S. Georas
	Lysophosphatidic acid enhances interleukin-13 gene expression and promoter activity in T cells
	Am J Physiol Lung Cell Mol Physiol, January 1, 2006; 290(1): L66 - L74. [Abstract] [Full Text] [PDF]

<input checked="" type="checkbox"/> Home page	N. M. Urs, K. T. Jones, P. D. Salo, J. E. Severin, J. Trejo, and H. Radhakrishna
	A requirement for membrane cholesterol in the {beta}-arrestin- and clathrin-dependent endocytosis of LPA1 lysophosphatidic acid receptors
	J. Cell Sci., November 15, 2005; 118(22): 5291 - 5304. [Abstract] [Full Text] [PDF]

<input checked="" type="checkbox"/> Home page	D. A. Lin and J. A. Boyce
	IL-4 Regulates MEK Expression Required for Lysophosphatidic Acid-Mediated Chemokine Generation by Human Mast Cells
	J. Immunol., October 15, 2005; 175(8): 5430 - 5438. [Abstract] [Full Text] [PDF]

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A. A. Maghazachi

Insights into Seven and Single Transmembrane-Spanning Domain Receptors and Their Signaling Pathways in Human Natural Killer Cells

Pharmacol. Rev., September 1, 2005; 57(3): 339 - 357.

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page

W. T. Wu, C.-N. Chen, C. I. Lin, J. H. Chen, and H. Lee

Lysophospholipids Enhance Matrix Metalloproteinase-2 Expression in Human Endothelial Cells

Endocrinology, August 1, 2005; 146(8): 3387 - 3400.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

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page

M. Yang, W. W. Zhong, N. Srivastava, A. Slavin, J. Yang, T. Hoey, and S. An

G protein-coupled lysophosphatidic acid receptors stimulate proliferation of colon cancer cells through the {beta}-catenin pathway

PNAS, April 26, 2005; 102(17): 6027 - 6032.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

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page

S. Ishii, Y. Kihara, and T. Shimizu

Identification of T Cell Death-associated Gene 8 (TDAG8) as a Novel Acid Sensing G-protein-coupled Receptor

J. Biol. Chem., March 11, 2005; 280(10): 9083 - 9087.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

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page

K. Itagaki, K. B. Kannan, and C. J. Hauser

Lysophosphatidic acid triggers calcium entry through a non-store-operated pathway in human neutrophils

J. Leukoc. Biol., February 1, 2005; 77(2): 181 - 189.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

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page

S. Bagga, K. S. Price, D. A. Lin, D. S. Friend, K. F. Austen, and J. A. Boyce

Lysophosphatidic acid accelerates the development of human mast cells

Blood, December 15, 2004; 104(13): 4080 - 4087.

[\[Abstract\]](#) [\[Full Text\]](#) [\[PDF\]](#)

<input checked="" type="checkbox"/> Home page	<p>N. Murakami, T. Yokomizo, T. Okuno, and T. Shimizu G2A Is a Proton-sensing G-protein-coupled Receptor Antagonized by Lysophosphatidylcholine J. Biol. Chem., October 8, 2004; 279(41): 42484 - 42491. [Abstract] [Full Text] [PDF]</p>
-----------------------------------------------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

<input checked="" type="checkbox"/> Home page	<p>R. Cummings, Y. Zhao, D. Jacoby, E. W. Spannhake, M. Ohba, J. G. N. Garcia, T. Watkins, D. He, B. Saatian, and V. Natarajan Protein Kinase Cδ Mediates Lysophosphatidic Acid-induced NF-κB Activation and Interleukin-8 Secretion in Human Bronchial Epithelial Cells J. Biol. Chem., September 24, 2004; 279(39): 41085 - 41094. [Abstract] [Full Text] [PDF]</p>
-----------------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

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-----------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

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-----------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

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-----------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

<input checked="" type="checkbox"/> Home page	<p>J. Xu, Y.-J. Lai, W.-C. Lin, and F.-T. Lin TRIP6 Enhances Lysophosphatidic Acid-induced Cell Migration by Interacting with the Lysophosphatidic Acid 2 Receptor J. Biol. Chem., March 12, 2004; 279(11): 10459 - 10468. [Abstract] [Full Text] [PDF]</p>
-----------------------------------------------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

<input type="checkbox"/> Home page	<p>D.-S. Im Discovery of new G protein-coupled receptors for lipid mediators J. Lipid Res., March 1, 2004; 45(3): 410 - 418. [Abstract] [Full Text] [PDF]</p>
------------------------------------	---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

<input type="checkbox"/> Home page	<p>T. Yamada, K. Sato, M. Komachi, E. Malchinkhuu, M. Tobo, T. Kimura, A. Kuwabara, Y. Yanagita, T. Ikeya, Y. Tanahashi, <i>et al.</i> Lysophosphatidic Acid (LPA) in Malignant Ascites Stimulates Motility of Human Pancreatic Cancer Cells through LPA1 J. Biol. Chem., February 20, 2004; 279(8): 6595 - 6605. [Abstract] [Full Text] [PDF]</p>
------------------------------------	----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

<input type="checkbox"/> Home page	<p>H. Ohta, K. Sato, N. Murata, A. Damirin, E. Malchinkhuu, J. Kon, T. Kimura, M. Tobo, Y. Yamazaki, T. Watanabe, <i>et al.</i> Ki16425, a Subtype-Selective Antagonist for EDG-Family Lysophosphatidic Acid Receptors Mol. Pharmacol., October 1, 2003; 64(4): 994 - 1005. [Abstract] [Full Text] [PDF]</p>
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